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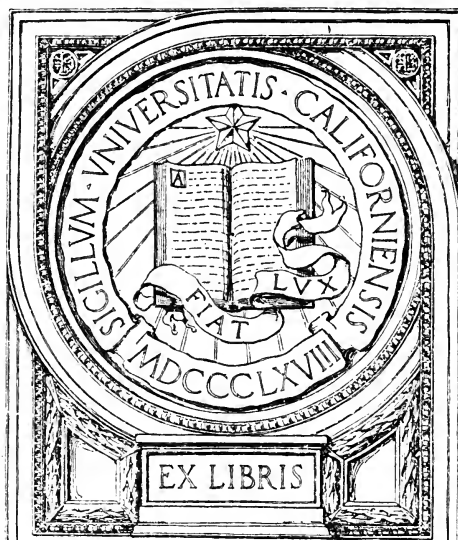
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AN EXPERIMENTAL STUDY OF GROUPING BY
SIMILARITY AS A FACTOR IN THE
TEACHING OF SPELLING

Important Facts Revealed by the Investigation, and Methods of
Computation That Give a Basis For Comparative
Interpretation of Results From Experi-
mental Pedagogy, Are Also
Included

A Thesis Presented to the Faculty of the Graduate School of
the University of Pennsylvania in part fulfillment
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Doctor of Philosophy

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AN EXPERIMENTAL STUDY OF GROUPING BY SIMILARITY AS A FACTOR IN THE TEACHING OF SPELLING

By CHARLES A. WAGNER

West Chester, Pa.

AN INVESTIGATION TO DETERMINE THE EFFICIENCY OF TEACH-
ING SPELLING IF THE WORDS BE GROUPED ACCORD-
ING TO "GROUP" DIFFICULTY IN SPELLING.

I. INTRODUCTION.

An investigation conducted by myself, for Doctor Yocum's Seminar in Pedagogy, in 1908, yielded the tentative conclusion that "Etymology is an effective help in spelling after considerable of the Grammar of the Classical languages is known." This raised the question of the effectiveness for spelling of forms of grouping other than Etymological, as phonetic difficulty, similar silent letters, and so on.

The next year an investigation of special devices in spelling, such as rhymes or jingles for "ie" and "ei" words, brought to light the existence of a large number of such devices among educated people. This result gave further impetus to the question, "What is the degree of efficiency of 'group' association in spelling"?

In most instances spelling books have the words arranged into groups. The groups are either words of the same degree of difficulty or else of names of things "found in the parlor", "in the attic", and so on. To learn the names of all the things in the parlor becomes easy from such a list, but it is the words and not their spelling that seems to be helped by the grouping, unless it should be found that in some way the recollection of the words in such a "contiguous" list also helps the spelling of these words. The principle of grouping applied in this experiment is the principle of analogy or similarity of *spelling difficulty*.

Doctor J. M. Rice, in discussing his findings in his well-known spelling investigation in American cities, says (Forum, vol. 23, page 417): ". . . the course [in spelling] is open to simplification by separating words that may be learned collectively from those that must be learned individually . . . That little advantage is now taken of rules in spelling is indicated by

the fact that, broadly speaking, as many errors were made on words governed by rules as on those to which rules do not apply."

These considerations pointed the way to this investigation. What is the measurable advantage, under actual school conditions, of teaching the spelling of words grouped according to a common difficulty in their spelling? It seemed both desirable and possible to arrange a test to measure such efficiency: the selection of two classes of children, in the same set of schools, alike in grading and school age, must, of course, be the laboratory in which the test is to be made. If one class of children study their spelling words in the usual way, and the other class study the same words, but study them according to groups on the basis of similar difficulty in spelling, the difference of advantage one way or the other would be likely to appear. The attempt was made, in the experiment, to keep all the conditions alike, except the spelling lessons. In one class the source of the words determined their place in the lessons, in the other class, it was the kind of spelling difficulty found in the word. It was also hoped that the test might show the relative advantages among the kinds or groups of spelling difficulty selected in classifying the words for the second class.

Does such method tend to build up a habit of associating new words with the groups learned? seemed another important problem upon which it was hoped some light might be found. Because such an investigation must extend over years, it was impossible to get any light on the formation of such a tendency. Were such a tendency sure to follow from the method, and there seems much reason for believing that it does, it would be more valuable than the results found by this investigation. The spelling of his vocabulary is not nearly so valuable to the child as the habit of learning new words as he encounters them. This is surely to be aimed at by all teaching of spelling.

No method is simple. All methods are complex, made up of many factors. When the final method of teaching spelling is formulated, therefore, shall the grouping of words according to similarity of spelling difficulty be one of those factors? became the final problem of this study.

II. WHERE CONDUCTED.

The schools of a borough in Pennsylvania with supervision by the School Principal were available for the experiment, and offered favorable conditions. There are two school buildings in the town. The buildings are about half of the length of the town apart. This was of advantage since it hindered the exchange of experiences by the pupils in the two classes while the experiment was in progress. Each of the buildings had a class of sixth grade pupils, boys and girls in each class. The teaching ability of the teachers who had charge of these rooms was rated as about

equal by the Principal, who assisted in the conduct of the investigation. At first, the intention had been to include seventh and eighth grade pupils also, to find if possible, how far these older children use reasoning power in spelling. In the schools selected there were no parallel grades seven and eight in the two schools, so this part of the search had to be given up. Making deductions for absence from the tests, in one class, that which studied its words grouped according to likeness of spelling difficulty, there were twenty-eight (28) pupils; in the report this class is called *Class A*. In the class which studied the words in the usual way, there remained twenty-two (22) pupils. This class will be called *Class B*.

III. THE WORDS CHOSEN FOR THE TEST.

Two hundred words were agreed upon as the test. A smaller number, it was feared, might be remembered by association by contiguity alone. That number seemed to be enough to test the efficiency of grouping; it would give enough groups and would permit of considerable variation in the sizes of the groups. This seemed necessary to bring the "group" difficulty into active use both in learning and in recalling the words. A larger number would have made a serious interference in the regular work of these classes in their schools. Also it would have required too much time to complete, and it seemed that the work as here planned and described would yield tentative results of value. If grouping in study has any efficiency in learning and recalling the spelling of words, it seemed likely to appear as the result of the experiment as here planned, even if larger and more important results must be neglected.

The words for the test were selected from the other text books studied by these classes. Their reader, history, geography, physiology and grammar texts were carefully examined, and words were chosen from those parts of these texts which had already been gone over that term. This was done to make sure of content or meaning for the words, and it also made as sure as conditions permitted that the words in the spelling lists would not come up and be studied in other lessons during the time of the test.

For *Class A*, the words were arranged into thirty (30) groups, each group having the same spelling difficulty. Then ten (10) lessons were arranged, each lesson containing from one to three words from each of six or eight of the different groups. This was done to conform to the practice of the school, twenty (20) words to the spelling lesson. In *Class B* there were also twenty (20) lessons arranged, chiefly according to the order in which the words were selected from the text books. In the preliminary test and in the final test, the children spelled fifty (50) words

each day for four days. The total time taken for the tests and lessons was thus exactly twenty (20) days, just a school month.

IV. GROUPING THE WORDS.

Thirty bases of grouping were chosen, and the words put into the group which seemed to represent the greatest difficulty in the word. The smallest group had two words, the largest had sixteen (16) words. With such a small number of words it was impossible to include all the words of like difficulty that might belong to any group. The method of selection excluded all words not found in the text books, hence choosing from spellers or dictionaries, just to secure an exhaustive list, was precluded. It seems probable that the group containing the group difficulty called the "line" group, Group one, approaches very closely to containing all the words commonly used. The words themselves and the grouping, as well as the "group" difficulties selected, will all be shown in the table of results, and are therefore omitted here.

The continuous repetition of the "group" difficulty, as provided in the lessons for Class A, seemed necessary, to secure the highest possible degree of certainty that the "group" difficulty should be learned, that the words in the group should be associated with it, and so that dependence upon it should have a chance to develop. It is believed, for instance, that to have learned all the words of a few groups as a single lesson, and not to have repeated the group after that, would have afforded a minimum chance for any advantage of grouping to show itself. To train the child to depend upon grouping, he must use grouping frequently, so that "group" analogy shall function certainly and quickly.

V. PRELIMINARY TEST.

A preliminary test was decided upon as a basis from which to measure the improvement of each class. Both classes were given the entire list of two hundred (200) words to spell, in lessons of fifty (50) words each, without any fresh study of them. The results attained in this test are the basis from which improvement is reckoned. The regular teachers conducted these tests. The children were not told what was in progress, except that it was review work in spelling. This probably secured normal conditions and the children's best effort. Only the results for the classes as a whole are shown. In the report to the Seminar, no difference by sexes was noticeable, hence they are here omitted.

VI. METHOD OF PRESENTATION OR TEACHING THE WORDS.

After the preliminary test, actual study of the entire list of words, was begun by each class. In Class A, the "grouping" class, each word of a twenty (20) word lesson was written upon

the black-board by the teacher. If any child could use the word in a sentence or give its meaning so that the entire class understood, then the class was assumed to know the meaning of the word. If no child could tell its meaning, the teacher, by suggestion or hint, tried to recall the connection where the class had met the word, and thus, if possible, secured the recall of a meaning already learned. Meaning, or content for the word, even if but partial, being thus assured, each of the following steps was taken if the learning of groups had gone ahead far enough to require it:

- (1) To which group of our list may this word be added?
- (2) What words have we already learned that will help us to remember this?
- (3) Name *all* the words already learned that will help you to remember this one?

Then each word was written two times, to conform to the regular practice of this class and teacher.

In *Class B*, the proceeding was the same while making sure that the words had meaning or content. Then some pupil was asked to point out the hard part of the word, or the place where one would be likely to make a mistake in spelling. Some likely mistake was always found. Had the teacher been instructed to point out the difficulty for the children, it was feared that stress might be put upon the same difficulty in both classes. The results seem to show that the class that studied its words in ordinary lists yet hit upon group spelling difficulty as the "hard part" of the word.

Next each word was written three times, to conform with the usual custom of this class and teacher. In both classes this so-called writing the words means the writing of each word in immediate succession. Should the writing of the words two times in one class and three times in the other be regarded as a serious variation? Since it was *Class B* that wrote them oftener, and since it was *Class A* that was trying the "grouping," it seemed clear that whatever advantage there might be in the three writings, must accrue to the *Class B*, which studied its words in the ordinary groups. Therefore this conformity to usual school conditions seemed better: it gave the children no chance to become curious or suspicious that something unusual was going on. Normal states of mind and attitude toward the work were thus secured and maintained. Since favorable results, if any, would be against "grouping" rather than in favor of it, the variation is here mentioned merely as an explanation, not with the belief that it caused any disturbance whatever in the results.

VII. THE SPELLING LESSONS.

All spelling lessons, and all the test exercises, were given in the first period of the afternoon session of the school, between 1.45 and 2.15 p.m. The first ten minutes were given to the presentation of the words after the plan already described. Then followed the writing of the words—the study: for this study or writing, twenty minutes, or as much of it as was needed, was given to the writing or practicing from the black-board copy. Then the lesson of twenty words was pronounced to be spelled in the usual way. All papers were then collected. The teachers and the investigators marked the papers. Papers were not returned to the children.

Each teacher noted the words misspelled in the lessons. When the entire list of words had been studied and spelled, these lists of misspelled words were treated as two new lessons, each word being again presented as if it were a new word. The papers of the review lessons were not kept, the errors were not counted, and no record of them is included here. Since each class of children gave extra study to those words which appeared more difficult, it seems permissible to omit this phase of the work. The misspelled words were restudied to conform to the practice of the school. This variation told against Class B if it made any difference, since that class missed the larger number of words in the daily lessons. Probably this difference is so slight as to be entitled to mention only and not to actual consideration or computation.

VIII. MARKING AND COUNTING ERRORS.

Two classes of errors were arranged as the basis for tabulation and comparison. Misspelling of any kind made a word wrong. Next, words that were wrong were examined for the kind of mistake or mistakes that had been made. Any error due to not knowing or not using the "group" difficulty was called a group error. All other kinds of errors, such as omitted letters, wrong letters, and so on, were called "non-group" errors. For instance, the word "conscience," if written "consience," was counted wrong and the error was regarded a "grouping" error; if written "consciense," the error was called a "non-grouping" error. This classification of errors furnished the basis for determining the effectiveness of "grouping" in eliminating "group" errors, and also for the comparison of the groups as to relative efficiency.

There were, of course, many more errors than misspellings: that is, some words had several mistakes in them, some having as many as four errors in the preliminary test. In computing the class standing, only the number of misspelled words was counted. In computing the efficacy of the groups and of the grouping, the number of errors was also included.

In marking the words, the singular difficulty came to light that some words might with equal propriety be included under several "groups" of difficulty. Thus "conception," although actually included in the etymological group, might also have been included in the "group" "tion as shun." In such cases, the error was counted as a grouping error if the "group" difficulty under which the word was studied was not used in the spelling. Thus, an error resulting from not remembering "cept" as the group difficulty for "conception," was regarded as a group error, and anything else in this word as a non-group" error. Words omitted in the lessons or tests by any pupils, or words substituted for those pronounced by the teacher were all counted as "non-grouping" errors.

The group of words ending in "y" in the singular seems to present no group difficulty; in the plural the rule for spelling "y" plurals was used, so that rules of spelling, as suggested by Rice, have had a small trial here.

Many perplexing decisions had to be made in marking the papers and in classifying the errors. "Graphophone" was most frequently misspelled by writing it "graphone." It had been grouped with the "graph" words: the "graph" is present, but shall we call it a grouping or a non-grouping error? Did the child write "graph one" or "gra phone"? As the words had not been written in syllables, we could not tell absolutely. For safety's sake—to avoid the suspicion of trying to make out a case for the experiment—all such errors were counted as non-grouping. Only clear and unmistakable cases of ignorance or non-use of the "group" difficulty were counted "grouping" errors: all others were counted as "non-grouping."

IX. MARKING THE PAPERS.

First the teachers marked the papers: then the investigators looked them over, confirmed the markings, and classified the errors. Then the counts were taken. This precaution seemed best to guard against any disposition to find errors in favor of the test, namely, "group" errors. In the tables of results, the "grouping errors" are called "g" errors, and the "non-grouping" errors are called "ng" errors.

X. RESULTS.

For convenience of all kinds, the figures for both tests are placed side by side in the tables. The words are there arranged into groups as they were listed for the "grouping" class, under their respective "group" headings. The table is intended to show just what were the results for each word, for each group of words, and for each class, in both tests.

The results of the daily spelling lessons do not appear in the table. For the sake of completeness, they are stated here. Class A, 28 pupils, missed a total of 109 words, during the time of daily lessons. Class B, in the same time, missed 110 words, but it had only 22 pupils. The average for Class A is thus 3.9 words per pupil for the ten lessons, and for Class B it is 5 words per pupil. In the preliminary test, it will be noticed, that Class A had the poorer showing, so that this difference at once becomes a difference in favor of the "grouping" here tried.

The attendance of the pupils during the time of the lessons was as follows:

Class A: 3 pupils absent for one lesson each, 2 pupils absent for 2 lessons each, and 2 pupils absent for 4 days each, a total of 15 days..

Class B: 4 pupils absent for 1 day each, and one pupil absent 2 days, a total of 6 days.

Class A thus was present less than 91% of the learning time, and Class B was present nearly 98% of that time. Class A, the "grouping" class, made the poorer showing at the start, was present a smaller percentage of the learning time, yet it made the better showing in the lessons. As an indication this difference is entitled to statement here.

Since each class had two days of review, and since the reviews are not counted in the results of the daily lessons, it is only the trend of the lessons that may be summarized.

Tabulation of results, showing misspellings and numbers of the several kinds of errors:

CLASS A. (GROUPING METHOD OF STUDY.) 28 Pupils in Class.						CLASS B. (NON-GROUPING METHOD OF STUDY.) 22 Pupils in Class.						
MISSPELLINGS		ERRORS				MISSPELLINGS		ERRORS				
Prelim. Final Test. Test.		Grouping Prel. Fin.		Non-grouping Prel. Fin.		Prelim. Final Test. Test.		Grouping Prel. Fin.		Non-grouping Prel. Fin.		
GROUP 1, "line" as base; 4 words:												
15	1	7	1	10	0	lineage	11	0	8	0	5	0
18	1	16	1	11	0	lineal	13	1	12	0	4	1
21	2	12	1	15	1	lineament	18	3	12	1	10	2
24	0	19	0	14	0	linear	18	1	12	0	12	1
—	—	—	—	—	—	—	—	—	—	—	—	—
78	4	54	3	50	1		60	5	44	1	21	4
GROUP 2, "que" as k; 6 words:												
25	1	21	0	21	1	arabesque	22	3	22	1	14	2
26	0	25	0	12	0	grotesque	18	3	16	0	12	3
4	0	2	0	3	0	oblique	9	0	4	0	6	0
1	1	1	0	0	1	opaque	12	3	11	1	5	2
25	1	25	0	3	1	picturesque	13	1	11	0	5	2
18	7	14	6	4	4	pique	13	4	10	1	13	3
—	—	—	—	—	—	—	—	—	—	—	—	—
99	10	88	6	43	7		87	14	74	3	55	12
GROUP 3, "verd" as green, as base; 4 words:												
21	2	3	0	20	2	Cape Verde	14	0	4	0	13	0
19	1	15	1	6	0	verdant	7	5	1	5	7	0
20	5	12	5	16	1	verdure	13	2	9	2	6	0
4	1	0	0	4	1	Vermont	11	4	0	0	1	4
—	—	—	—	—	—	—	—	—	—	—	—	—
64	9	30	6	46	4		35	11	14	7	27	4

CLASS A.
(GROUPING METHOD OF STUDY.)
28 Pupils in Class.

MISSPELLINGS		ERRORS			
Prelim.	Final	Grouping		Non-grouping	
Test.	Test.	Prel.	Fin.	Prel.	Fin.

GROUP 4, "ch" as k; 11 words:

24	1	24	0	24	1	catechism
22	2	19	0	16	2	chasm
7	0	3	0	5	0	chemist
28	5	27	4	28	5	choleric
21	0	21	0	6	0	chord
1	0	1	0	1	0	chorus
16	2	2	0	16	2	Christian
5	0	0	0	5	0	Christmas
19	4	8	1	27	4	chrysalis
9	1	8	0	4	1	monarch
24	6	18	3	16	4	patriarch
—	—	—	—	—	—	—
176	21	131	8	148	19	

GROUP 5, "ci" as sound of sh; 4 words:

25	1	17	1	14	0	capacious
17	0	14	0	12	0	ferocious
1	1	0	0	1	1	precious
19	5	10	4	16	3	vicious
—	—	—	—	—	—	—
69	7	41	5	43	4	

GROUP 6, "geon" as jon; 5 words:

23	1	23	1	10	0	bludgeon
19	0	19	0	12	0	dungeon
3	1	3	0	1	1	pigeon
16	6	5	2	15	6	surgeon
12	1	7	1	11	1	sturgeon
—	—	—	—	—	—	—
73	9	57	4	49	8	

GROUP 7, "tyr" as ter; 3 words:

11	2	9	2	3	0	martyr
4	1	4	0	1	1	martyrdom
27	3	25	3	7	1	satyr
—	—	—	—	—	—	—
42	6	38	5	11	2	

GROUP 8, "ti" as sh; 6 words:

27	0	22	0	14	0	insatiate
20	1	0	1	20	0	inartial
15	0	10	0	12	0	partial
4	0	1	0	4	0	patience
1	1	0	0	1	1	patient
7	1	3	1	5	0	quotient
—	—	—	—	—	—	—
74	3	36	2	56	1	

GROUP 9, "ant" as ent; 7 words:

27	0	10	0	27	0	buoyant
7	1	6	1	3	1	claimant
6	2	5	1	2	1	gallant
9	3	9	2	0	1	informant
3	0	2	0	1	0	radiant
12	0	8	0	8	0	tenant
21	0	10	0	17	0	truant
—	—	—	—	—	—	—
85	6	50	4	58	3	

GROUP 10, "cept" as base; 6 words:

11	0	0	0	11	0	accept
22	2	18	2	5	0	conception
7	1	3	0	4	1	exception
16	2	11	0	6	2	intercept
7	0	7	0	2	0	precept
10	0	7	0	4	0	reception
—	—	—	—	—	—	—
73	5	46	2	32	3	

CLASS B.
(NON-GROUPING METHOD OF STUDY.)
22 Pupils in Class.

MISSPELLINGS		ERRORS			
Prelim.	Final	Grouping		Non-grouping	
Test.	Test.	Prel.	Fin.	Prel.	Fin.

18	4	14	1	20	4
14	2	11	0	14	2
3	1	1	0	3	1
21	5	20	4	18	4
12	2	11	2	5	0
5	1	1	0	4	1
4	6	0	0	4	6
2	0	1	0	2	0
21	4	15	2	22	2
8	0	8	0	0	0
14	1	12	0	8	2
—	—	—	—	—	—
122	26	94	9	100	22

16	2	11	0	11	2
13	2	7	1	14	1
2	0	0	0	3	0
14	2	8	1	9	1
—	—	—	—	—	—
45	6	26	2	37	4

21	3	16	1	12	0
10	0	9	0	5	0
1	1	1	0	0	1
15	1	6	0	12	1
6	1	5	0	6	1
—	—	—	—	—	—
53	6	37	1	35	5

3	0	1	0	2	0
4	1	1	0	4	1
22	13	21	12	5	4
—	—	—	—	—	—
29	14	23	12	11	5

19	5	19	4	11	1
13	2	12	2	5	2
12	1	8	1	6	1
3	1	0	0	3	1
3	0	0	0	3	0
5	0	4	0	4	0
—	—	—	—	—	—
55	9	43	7	32	5

21	6	8	0	18	16
1	2	1	2	0	0
10	0	7	0	8	0
8	2	8	2	1	6
2	1	0	0	2	1
11	3	5	1	6	2
8	3	5	3	4	2
—	—	—	—	—	—
61	17	34	8	39	11

4	2	1	0	3	2
16	6	16	5	3	1
2	0	1	0	1	0
5	4	4	4	1	0
4	1	4	0	1	1
3	1	3	0	0	1
—	—	—	—	—	—
34	14	29	9	9	5

CLASS A.
(GROUPING METHOD OF STUDY.)
28 Pupils in Class.

CLASS B.
(NON-GROUPING METHOD OF STUDY.)
22 Pupils in Class.

MISSPELLINGS ERRORS
Prelim. Final Grouping Non-grouping
Test. Test. Prel. Fin. Prel. Fin.

GROUP 11, "ph" as f; 8 words:

15	1	2	0	15	1
3	2	0	0	3	2
26	3	20	1	23	3
4	3	1	2	3	2
10	0	2	0	10	0
5	1	2	0	6	1
16	0	3	0	16	0
10	0	4	0	11	0
—	—	—	—	—	—
89	10	34	3	92	9

GROUP 12, "graph" as base; 10 words:

15	3	0	1	15	3
8	0	3	0	9	0
1	0	0	0	1	0
8	0	8	0	0	0
13	1	5	0	12	1
28	2	3	0	28	2
7	1	3	0	4	1
20	1	1	0	19	1
1	0	0	0	1	0
1	0	0	0	1	0
—	—	—	—	—	—
102	2	23	1	90	8

GROUP 13, "gyp" as jip; 3 words:

1	2	0	0	1	2
27	2	3	0	26	2
1	0	0	0	1	0
—	—	—	—	—	—
29	4	3	0	28	4

GROUP 14, "sc" as s; 8 words:

4	1	2	1	4	0
6	0	5	0	1	0
9	0	0	0	2	0
20	0	15	0	13	0
6	2	5	2	1	0
22	2	12	1	13	1
4	1	3	0	3	1
0	0	0	0	0	0
—	—	—	—	—	—
71	6	51	4	37	2

GROUP 15, "h" silent; 5 words:

26	0	26	0	8	0
10	1	10	0	3	1
1	1	0	0	1	1
0	0	0	0	0	0
11	0	3	0	9	0
—	—	—	—	—	—
48	2	39	0	21	2

GROUP 16, "eigh" as long a; 5 words:

28	0	28	0	3	0
14	0	13	0	3	0
0	0	0	0	0	0
2	0	2	0	0	0
0	0	0	0	0	0
—	—	—	—	—	—
44	0	43	0	6	0

GROUP 17, "mission" as base; 6 words:

10	0	6	0	7	0
6	0	4	0	2	0
11	0	10	0	2	0
6	0	5	0	2	0
9	0	9	0	1	0
8	0	8	0	0	0
—	—	—	—	—	—
50	0	42	0	14	0

MISSPELLINGS ERRORS
Prelim. Final Grouping Non-grouping
Test. Test. Prel. Fin. Prel. Fin.

7	1	1	0	7	2
0	1	1	0	0	1
16	7	2	0	17	7
5	2	2	1	5	1
4	2	1	0	4	2
0	0	0	0	0	0
14	12	3	2	12	11
5	0	3	0	2	0
—	—	—	—	—	—
51	25	12	3	47	24

6	2	0	1	7	1
4	0	0	0	4	0
0	0	0	0	0	0
8	0	8	0	0	0
13	1	9	1	8	1
15	1	4	1	14	0
3	1	1	0	2	1
3	1	0	0	3	1
3	1	1	0	2	1
0	0	0	0	0	0
—	—	—	—	—	—
55	7	23	3	40	4

4	1	3	0	1	1
10	2	0	0	11	2
5	0	3	0	2	0
—	—	—	—	—	—
19	3	6	0	14	3

0	0	0	0	0	0
6	1	6	1	1	0
12	1	10	1	4	0
12	3	10	3	3	1
3	1	2	0	1	1
15	3	9	2	12	2
4	0	1	0	3	0
1	2	1	1	0	1
—	—	—	—	—	—
53	11	39	8	24	5

18	2	16	2	10	0
4	0	2	0	4	0
0	0	0	0	0	0
2	0	2	0	0	0
7	2	6	0	4	2
—	—	—	—	—	—
31	4	28	2	18	2

22	1	21	1	26	0
17	0	12	0	6	0
0	0	0	0	0	0
1	1	1	1	0	0
0	0	0	0	0	0
—	—	—	—	—	—
40	2	34	2	32	0

4	0	3	0	1	0
0	0	0	0	0	0
5	1	3	1	2	0
1	0	0	0	1	0
2	1	2	0	0	1
2	0	2	0	0	0
—	—	—	—	—	—
14	2	10	1	4	1

CLASS A.
(GROUPING METHOD OF STUDY.)
28 Pupils in Class.

CLASS B.
(NON-GROUPING METHOD OF STUDY.)
22 Pupils in Class.

MISSPELLINGS		ERRORS				MISSPELLINGS		ERRORS				
Prelim.	Final	Grouping		Non-grouping		Prelim.	Final	Grouping		Non-grouping		
Test.	Test.	Prel.	Fin.	Prel.	Fin.	Test.	Test.	Prel.	Fin.	Prel.	Fin.	
GROUP 18, "y" preceded by a constant, plural nouns; 9 words:												
7	0	5	0	2	0	canaries	7	1	5	1	2	0
6	2	5	1	5	2	canopies	7	4	3	2	4	2
2	1	0	0	2	1	colonies	2	0	1	0	1	0
7	1	3	0	4	2	deliveries	6	0	2	0	4	0
18	1	3	0	15	1	quantities	8	1	2	0	6	1
13	3	5	0	8	3	securities	9	1	7	0	2	1
2	0	2	0	0	0	stories	1	0	1	0	0	0
16	1	7	0	12	1	tapestries	13	0	9	0	5	0
2	0	0	0	2	0	tributaries	2	1	0	0	2	1
73	9	30	1	50	10		55	8	30	3	26	5
GROUP 19, "ie" as long e; 10 words:												
6	4	5	4	1	0	believe	4	3	4	3	0	0
1	0	0	0	1	0	chief	1	1	1	1	0	0
23	1	11	1	19	0	fiend	5	2	4	1	1	1
3	0	2	0	1	0	fierce	1	1	1	1	1	0
7	1	5	1	2	1	grieve	5	1	4	1	2	0
4	2	2	1	2	1	piece	6	3	3	3	3	0
1	0	0	0	1	0	pierce	3	1	3	1	0	0
3	0	2	0	1	0	thief	2	1	2	1	0	0
26	2	26	2	24	0	wield	17	3	10	1	13	2
77	10	55	9	53	2		46	17	34	14	20	3
GROUP 20, "scio," to know, as base; 2 words:												
5	1	2	0	4	2	conscience	6	4	2	0	6	4
8	0	4	0	6	0	conscious	8	3	5	1	4	2
13	1	6	0	10	2		14	7	7	1	10	6
GROUP 21, singular "y" preceded by a consonant nouns (no grouping for these); 9 words:												
1	0	0	0	1	0	canary	4	1	0	0	4	1
8	0	0	0	8	0	canopy	2	0	0	0	2	0
1	1	0	0	1	2	colony	1	2	0	0	1	2
5	1	0	0	5	1	delivery	0	1	0	0	0	1
17	1	0	0	17	1	quantity	9	2	0	0	9	2
5	1	0	0	5	1	security	0	1	0	0	0	1
0	0	0	0	0	0	story	1	1	0	0	1	1
14	4	0	0	14	4	tapestry	4	0	0	0	5	0
7	0	0	0	9	0	tributary	2	1	0	0	2	1
58	8	0	0	60	9		23	9	0	0	24	9
GROUP 22, "ea" as long e; 5 words:												
12	0	4	0	9	0	bereave	15	2	14	2	1	0
6	0	5	0	6	0	eager	3	0	2	0	2	0
4	0	0	0	4	0	easel	5	1	0	0	5	1
7	0	6	0	2	0	fearful	3	1	1	1	4	0
1	0	0	0	1	0	weasel	1	0	0	0	1	0
30	0	15	0	22	0		27	4	17	3	13	1
GROUP 23, "tion" as shun; 12 words:												
8	2	0	0	8	2	affliction	7	5	0	0	7	5
9	0	4	0	8	0	completion	1	0	1	0	0	0
0	0	0	0	0	0	direction	0	0	0	0	0	0
5	0	0	0	5	0	exertion	4	2	2	1	2	1
21	1	0	0	21	1	irrigation	18	10	1	0	23	11
1	0	0	0	1	0	objection	0	0	0	0	0	0
3	0	1	0	3	0	observation	1	1	0	0	1	1
0	0	0	0	0	0	perfection	1	0	0	0	1	0
3	1	1	0	2	1	reflection	1	0	0	0	1	0
13	2	1	0	15	2	suffocation	2	1	0	0	2	1
3	0	0	0	3	0	transaction	2	0	0	0	2	0
1	0	0	0	1	0	vegetation	4	2	0	0	4	2
67	6	7	0	67	6		41	21	4	1	43	21

CLASS A.
(GROUPING METHOD OF STUDY.)
28 Pupils in Class.

CLASS B.
(NON-GROUPING METHOD OF STUDY.)
22 Pupils in Class.

MISSPELLINGS		ERRORS			
Prelim.	Final	Grouping		Non-grouping	
Test.	Test.	Prel.	Fin.	Prel.	Fin.

GROUP 24, "t" silent; 9 words:

6	0	5	0	2	0	almond
7	0	3	0	6	0	balky
2	1	0	0	2	1	calm
0	0	0	0	0	0	chalk
4	0	1	0	4	0	embalm
6	0	0	0	6	0	Lincoln
1	0	0	0	1	0	palm
15	1	1	1	15	0	psalm
5	0	2	0	4	0	salmon
<hr/>		<hr/>		<hr/>		
46	2	12	1	40	1	

GROUP 26, "dg" as j; 16 words:

3	0	1	0	3	0	acknowledge
6	0	5	0	4	0	begrudge
2	0	0	0	2	0	bridge
13	0	5	0	12	0	cartridge
11	0	6	0	7	0	dodge
7	0	3	0	5	0	drudge
1	0	0	0	1	0	fledge
0	0	0	0	0	0	fudge
5	0	1	0	5	0	grudge
2	0	0	0	2	0	hedge
8	0	1	0	7	0	knowledge
5	1	1	1	5	1	ledger
4	0	2	0	2	0	pledge
1	0	0	0	1	0	ridge
1	0	1	0	0	0	sledge
5	0	3	0	3	0	wedge
<hr/>		<hr/>		<hr/>		
74	1	29	1	59	1	

GROUP 27, "gh" silent; 7 words:

2	1	0	0	2	1	bough
0	0	0	0	0	0	blight
15	1	0	0	15	1	haughtily
9	0	2	0	9	0	plight
2	1	0	0	2	1	thought
0	0	0	0	0	0	through
1	0	0	0	1	0	tight
<hr/>		<hr/>		<hr/>		
29	3	2	0	29	3	

GROUP 25, "n" silent; 5 words:

2	0	0	0	2	0	autumn
4	4	0	0	4	4	column
10	1	10	1	1	0	condemn
2	0	1	0	1	0	hymn
6	1	2	0	6	1	solemn
<hr/>		<hr/>		<hr/>		
24	6	13	1	14	5	

GROUP 28, "ern" meaning direction; 4 words:

1	0	0	0	1	0	eastern
3	0	1	0	2	0	northern
2	0	0	0	2	0	southern
1	1	1	0	1	1	western
<hr/>		<hr/>		<hr/>		
7	1	2	0	6	1	

GROUP 29, "gh" as f; 5 words:

1	0	1	0	0	0	enough
0	0	0	0	0	0	laugh
1	0	1	0	0	0	rough
2	0	0	0	2	0	slough
3	1	1	0	2	1	tough
<hr/>		<hr/>		<hr/>		
7	1	3	0	4	1	

MISSPELLINGS		ERRORS			
Prelim.	Final	Grouping		Non-grouping	
Test.	Test.	Prel.	Fin.	Prel.	Fin.

6	1	5	1	5	1	
3	0	1	0	2	0	
2	0	0	0	2	0	
2	0	0	0	2	0	
2	0	2	0	0	0	
2	0	1	0	1	0	
1	1	0	0	1	1	
9	1	1	0	8	1	
4	2	3	0	3	2	
<hr/>		<hr/>		<hr/>		
31	5	13	1	24	5	

0	0	0	0	0	0	
3	2	3	1	1	1	
0	0	0	0	0	0	
9	1	7	0	7	1	
0	1	0	0	0	1	
4	1	2	0	4	1	
0	0	0	0	0	0	
1	1	1	0	0	1	
1	0	1	0	0	0	
2	0	0	0	2	0	
3	1	1	1	3	0	
1	2	1	1	1	1	
1	0	0	0	1	0	
1	0	0	0	1	0	
1	0	0	0	1	0	
1	0	0	0	1	0	
<hr/>		<hr/>		<hr/>		
28	9	16	3	22	6	

1	0	1	0	1	0	
1	0	1	0	0	0	
7	4	3	0	7	4	
2	0	1	0	2	0	
1	3	0	0	1	3	
0	1	0	0	0	1	
0	0	0	0	0	0	
<hr/>		<hr/>		<hr/>		
12	8	6	0	11	8	

0	1	0	1	0	0	
8	5	4	0	8	5	
9	3	9	3	2	1	
0	0	0	0	0	0	
8	3	3	0	6	4	
<hr/>		<hr/>		<hr/>		
25	12	16	4	16	10	

4	0	4	0	0	0	
6	0	3	0	4	0	
3	0	2	0	1	0	
3	0	3	0	0	0	
<hr/>		<hr/>		<hr/>		
16	0	12	0	5	0	

0	1	0	0	0	1	
0	0	0	0	0	0	
4	1	3	0	3	1	
2	0	1	0	2	0	
2	0	0	0	2	0	
<hr/>		<hr/>		<hr/>		
8	2	4	0	7	2	

CLASS A.
(GROUPING METHOD OF STUDY.)
28 Pupils in Class.

MISSPELLINGS		ERRORS				
Prelim. Test.	Final Test.	Grouping		Non-grouping		
		Prel.	Fin.	Prel.	Fin.	
GROUP 30, "head" as base; 6 words:						
0	0	0	0	0	0	behead
0	0	0	0	0	0	deadhead
0	1	0	0	0	1	forehead
1	0	0	0	1	0	headache
3	0	0	0	3	0	headlong
4	1	0	0	4	1	hogshhead
8	2	0	0	8	2	

CLASS B.
(NON-GROUPING METHOD OF STUDY.)
22 Pupils in Class.

MISSPELLINGS		ERRORS				
Prelim. Test.	Final Test.	Grouping		Non-grouping		
		Prel.	Fin.	Prel.	Fin.	
0	1	0	0	0	1	
0	1	0	0	0	1	
1	0	0	0	1	0	
1	0	0	0	1	0	
0	0	0	0	0	0	
5	2	1	1	5	1	
7	4	1	1	7	3	

SUMMARIES BY GROUPS.

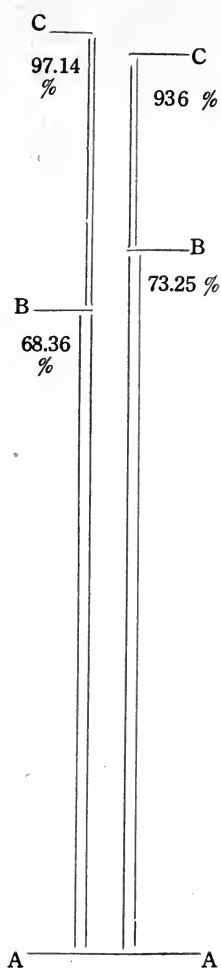
CLASS A, 28 Pupils.								CLASS B, 22 Pupils.							
GROUPS.	No. of words in gr'p.	Words Missed.		Errors, Grouping, Non-gr'ping.				Words Missed.		Errors, Grouping, Non-gr'ping.					
		Prel.	Fin.	Prel.	Fin.	Prel.	Fin.	Prel.	Fin.	Prel.	Fin.	Prel.	Fin.		
1. line	4	78	4	54	3	50	1	60	5	44	1	21	4		
2. que	6	99	10	88	6	43	7	87	14	74	3	55	12		
3. verd	4	64	9	30	6	46	4	35	11	14	7	27	4		
4. "ch"	11	176	21	131	8	148	19	122	26	94	9	100	22		
5. "ci"	4	62	7	41	5	43	4	45	6	26	2	37	4		
6. geon	5	73	9	57	4	49	8	53	6	37	1	35	5		
7. tyr	3	42	6	38	5	11	2	29	14	23	12	11	5		
8. "ti"	6	74	3	36	2	56	1	55	9	43	7	32	5		
9. ant	7	85	6	50	4	58	3	61	17	34	8	39	11		
10. cept	6	73	5	46	2	32	3	34	14	29	9	9	5		
11. "ph"	8	89	10	34	3	92	9	51	25	12	3	47	24		
12. graph	10	102	8	23	1	90	8	55	7	23	3	40	4		
13. gyp	3	29	4	3	0	28	4	19	3	6	0	14	3		
14. "sc"	8	71	6	51	4	37	2	53	11	39	8	24	5		
15. "h"	5	48	2	39	0	21	2	31	4	26	2	18	2		
16. eigh	5	44	0	43	0	6	0	40	2	34	2	12	0		
17. sion	6	50	0	42	0	14	0	14	2	10	1	4	1		
18. ies plur. ..	9	73	9	30	1	50	10	55	8	30	3	26	5		
19. "ie"	10	77	10	55	9	53	2	46	17	34	14	20	3		
20. scio	2	13	1	6	0	10	2	14	7	7	1	10	6		
21. "y" sing... 9	58	8	0	0	0	60	9	23	9	0	0	24	9		
22. "ea"	5	30	0	15	0	22	0	27	4	17	3	13	1		
23. tion	12	67	6	7	0	67	6	41	21	4	1	43	21		
24. "l"	9	46	2	12	1	40	1	31	5	13	1	24	5		
25. "n"	5	24	6	13	1	14	5	25	12	16	4	16	10		
26. "dg"	16	74	1	29	1	59	1	28	9	16	3	22	6		
27. "gh"	7	29	3	2	0	29	3	12	8	6	0	11	8		
28. ern	4	7	1	2	0	6	1	16	0	12	0	5	0		
29. "gh" (f)... 5	7	1	3	0	4	1	8	2	4	0	7	2	2		
30. head	6	8	2	0	0	8	2	7	4	1	1	7	3		
Totals:	200	1772	160	980	66	1246	120	1177	282	728	109	747	195		

COMPARISON: I. OF SPELLINGS.

	GROUP A (28 Pupils).		GROUP B (22 Pupils).	
	Preliminary.	Final.	Preliminary.	Final.
Total words to spell.....	5600	5600	4400	4400
Total words misspelled.....	1772	160	1177	282
Average misspelled per pupil.....	63.3	5.7	53.5	12.8
Standing of class.....	68.36%	97.14%	73.25%	93.6%

That is, Class A rose from 68.36% in the preliminary to 97.14% in the final test, and Class B rose from 73.25% in the preliminary to 93.6% in the final test.

Linear Representation of Results



The results of the tests as expressed in percentages are here shown in lines drawn on a similar scale.

Point B in each line represents the percentage made in the Preliminary Test ; point C represents the percentage made in the Final Test ; distance B C shows the gain made by each class.

Improvement for each class must be measured from point B. Class A began its improvement lower and ended higher, a fact thus made clear and conspicuous to the eye.

No method of computing the gain having heretofore been proposed, the following plan of comparison and computation is adopted. As far as known, the two classes represent approximately children of the same average ages and of the same relative school advantages. It would seem therefore as if Class B, having reached a higher mark in the preliminary test, must represent the better acquisitive power, in the ratio of 73.25 to 68.36.

According to the preliminary test, again, Class A had 100% minus 68.36%, or 31.64% to learn ; in the same way, Class B had but 26.75% to learn. Here, then, is another inequality, and it seems as if the chances of learning must be in proportion to the

quantity to be learned, or as if Class A's chances of learning were to Class B's as 31.64 to 26.75. This ratio appears warranted by the consideration of the fact that all the children study all the words. Therefore the group having most words to learn has the better chance to make gain or to learn words and to spell those words correctly in the final test which were misspelled in the preliminary test. Compounding these ratios, we get that—

Class A's rate of gain should be to Class B's rate of gain as, 68.36 to 73.25, and as 31.74 is to 26.75. If we now assume that B, being the group which uses the usual method, has a rate of gain of 1, we get a compound ratio that—

$$\begin{array}{rclcl} A & : & B & :: & A & : & B \\ & & & & :: & 68.36 & : & 73.25 \\ X & : & 1 & :: & 31.64 & : & 26.75 \end{array}$$

which worked out gives, X equals 1.1, meaning that the rate of gain in Class A must be 1.1 times as great as that of Class B if it is to show equal efficiency, and that whatever rate of gain greater than 1.1 Class A may show represents the relative efficiency of grouping as a factor in learning to spell.

The rate of gain of the two classes might be shown in each of several ways, such as the percentage of improvement in the final test, if the preliminary test be used as base, or in terms of what seemed unknown in the preliminary test. The latter plan is used here since that is the only process possible if a class start with an entirely unknown mass of facts. To adopt the "unknown of the preliminary test" as the basis for computing rate of learning will give uniformity between investigations where parts of the matter is known and those where none of it is known.

Class A had 31.64% of the original list to learn after the preliminary test, Class B had 26.75% to learn. As already shown Class A improved its standing in the final test by 28.78%; this is a rate of 91% of its unknown, of the 31.64% unknown. Class B. improved its standing by 20.35%, or at the rate of 70% of its unknown. A mere arithmetical difference here would show Class A doing better by the difference between 91%, A's rate of gain, and 70%, B's rate of gain, or 21% larger rate of gain in favor of Class A.

If the initial difference between the classes, as already pointed out and equated in the proportion of an earlier paragraph be valid, however, we should compare the classes with all possible inequalities eliminated. That proportion gave us the ratio of 1.1 rather than as absolute equality, and means that to do as well as Class B, Class A must show a rate of gain at least 1.1 times that of Class B. Now, Class B's rate of gain was 70%. Therefore to do as well as Class B, Class A must make 1.1 times 70%, or 77% of its unknown. Class A learned 91% of its un-

known, which is 14% better than 77%, and which is just 20% of B's own rate of gain better when all inequalities have been eliminated.

To learn words grouped according to similarity of difficulty in spelling thus seems about 20% better than the usual way, whether the advantage be computed as an arithmetical ratio or as an arithmetical difference. If this single factor of word-grouping thus adds 20% to the efficiency of teaching of spelling, it should certainly be included in the arrangement of spelling lessons of all kinds. Joining this unmistakable advantage as thus shown by the comparison of the tests to what was so clearly foreshadowed by the daily lessons, it seems proved that—

THE STUDY OF WORDS ARRANGED INTO GROUPS ACCORDING TO SIMILARITY IN SPELLING DIFFICULTY IS 20 PER CENT. BETTER THAN THE USUAL NON-GROUPING METHOD OF ARRANGEMENT AND STUDY.

II. COMPARISON OF ERRORS.

	CLASS A (28 Pupils)						CLASS B (22 Pupils).					
	Preliminary Test.			Final Test.			Preliminary Test.			Final Test.		
	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
	Total	% of	Av.	Total	% of	Av.	Total	% of	Av.	Total	% of	Av.
	No. of	whole	per	No. of	whole	per	No. of	whole	per	No. of	whole	per
	errors.	No.	pupil.	errors.	No.	pupil.	errors.	No.	pupil.	errors.	No.	pupil.
Grouping.....	980	44	35.	66	35.5	2.36	728	49	33.1	109	32.6	5
Non-grouping..	1246	56	44.5	120	64.5	4.3	747	51	34.	195	49.0	9

REDUCTION OF ERRORS:

	CLASS A	CLASS B
Grouping,	from an average of 35 to 2.36, or 93.3% :	from 33.1 to 5, or 85. %;
Non-grouping,	from an average of 44.5 to 4.3, or 90.4% :	from 34.0 to 9, or 73.5% ;

This shows the reduction per pupil for each class.

The fact that Class A had 44% of its errors of the grouping variety, and Class B 49%, in the preliminary test, shows that the grouping according to difficulty had been made quite successfully. As already stated, many words could quite properly have gone into other groups of this set, and in an attempt to incorporate this grouping idea into the arrangement of spelling lessons consisting of words grouped according to spelling difficulty that is what must be done.

The grouping errors were very considerably reduced in both classes; this shows that Class B must quite regularly have pointed out the group difficulty as "the place where you are likely to make a mistake" while preparing to study the words.

In Class A the non-grouping errors increase from 56% in the preliminary to 64.5% in the final test, which shows very markedly the good effect of the grouping for that kind of errors, and also confirms the statement that words having more than one difficulty must be studied in more than one group. In Class B the reverse took place. The non-grouping errors fell from 51%

to 49%. Apparently, the plan of having the children point out the difficulty in the word occasionally brought out some other than the group difficulty. The testimony of the teachers corroborates this indication. This comparison by errors brings out a fact which may be of great importance in the teaching of spelling, namely, the pedagogical mistake of calling a word wrong and deducting but one point of credit for each misspelled word, without regard to whether there was one or more than one error in the misspelling. Long standing practice and custom has established it as the right way, but it is at least worth asking, whether the desire to do well and to stand well in spelling would not be helped if the pupil knew that it was possible to lose more than one point for a misspelled word in case he made more than one mistake in it. Great difficulties would be encountered in attempting to apply such a method, as, for instance, shall we count the literal or the phonic errors? or, how shall we count omitted words? It seems probable that to count each word wrong as one point wrong being both easy to apply and having high practical value, may, therefore, be tolerated. Just as an example in an arithmetic test may be right "in principle" but wrong in computation, and therefore is refused full credit, so it would seem unfair to pupils who misspell words by but a single letter to suffer as much loss of credit as do pupils who have two or three errors in each misspelled word. Because the problem seems difficult is no reason for dismissing it, however. If one plan of marking and counting mistakes will arouse a more earnest and a higher pitch of effort to secure sustained excellence in spelling, that method should be developed as soon as possible. The act of calling the attention of the child to the particular difficulty which the word presents to him is certainly the first step toward helping him conquer that difficulty. It is doubtful whether we do that in our present way of marking and counting errors.

III. INCIDENTAL RESULTS.

As a matter of curiosity it will be worth while to state that four words were not missed in either test; they are *direction*, *laugh*, *neighbor*, *weight*. There were seven words not missed at all in the first test, and 54 words not missed at all in the final test. A remarkable fact came to light in tabulating the errors for the final test. It was discovered that in both classes there were misspellings of words in the final test which had been spelled correctly in the preliminary test. In Class A there were 53 such misspellings and in Class B there were 90 of them. Mere mass statistics could not have disclosed this fact. It came to light only when a record was compiled showing each pupil's work for each word in the preliminary and in the final test. Just what is the significance of this fact?

Evidently that guessing was present in the preliminary test; that the 28 pupils guessed right on 53 words in the preliminary, and wrong in the final; the 22 pupils guessed right on 90 words in the preliminary test, and and wrong in the final test. While it may be true that some of the mistakes in the final may have been mistakes of incoördination, yet on the whole the figures indicate the error that may creep into investigations of this kind by assuming, as is often done, that "the errors in the one group will offset the errors in the other," or, that in either group "the correct and incorrect guesses will offset each other." This could be true only in cases where the chances of error and of correctness were exactly even. That is, if there were but one wrong and one right way to spell a word. Since there is but one right way, and since there are innumerable possibilities of getting it wrong, the chances are very uneven, and the assumption of offset is not to be admitted. Scientific investigation must get the facts. In this investigation the 28 children averaged a trifle less than 2 right guesses in the preliminary test, and the same wrong guesses in the final test: the 22 children averaged a little more than 4 right guesses in the preliminary test and the same wrong guesses in the final test, and this after having studied the words rather intensively. It would certainly be interesting and valuable to find what would appear if there were no study of words or matter between two tests.

While this number of children was small, only fifty in all, it does not seem reasonable to suppose that it would equalize itself if the number were larger, say 1,000 or 10,000. The real wrong of the assumption is not that an equal number of children may be uncertain and guess; for the sake of the argument that may be conceded, just as we concede the insurance man's claim that so many people out of a thousand of a given age will die in any one year. If true, however, the difficulty, whether in spelling or in arithmetic, comes from assuming that those who guess or err have just as many chances to be right as to be wrong! The chances of error are greater than the chances of right, entirely independent of the number of children that do the guessing. In is the fact of hundreds of chances of wrongness to the one chance of rightness that decides the matter in favor of error.

XI. WORDS CORRECTLY SPELLED IN THE PRELIMINARY TEST BUT MISPELLED IN THE FINAL TEST.

The table showing such variation in misspelling is included for reasons that will appear presently.

CLASS A				CLASS B			
MISSPELLINGS.				MISSPELLINGS.			
In the Preliminary Test.	In the Final Test.		Individual pupils in numerical order.	In the Preliminary Test.	In the Final Test.		
	Same words as in Prelim. Test.	Different words from Prelim. Test.			Same words as in Prelim. Test.	Different words from Prelim. Test.	
75	3	0	1	38	4	0	
74	3	0	2	30	0	0	
34	2	0	3	29	2	0	
30	0	0	4	23	0	1	
70	2	0	5	65	7	1	
54	1	0	6	29	3	1	
67	2	0	7	45	3	1	
65	3	1	8	42	2	2	
57	0	1	9	54	3	2	
48	1	1	10	43	7	2	
71	1	1	11	69	12	2	
70	1	1	12	53	4	3	
24	0	1	13	83	8	3	
38	0	1	14	54	10	4	
21	0	1	15	57	4	5	
66	4	1	16	35	4	6	
54	2	1	17	90	23	7	
63	1	2	18	95	30	8	
94	3	2	19	55	15	8	
69	3	2	20	65	13	9	
44	2	3	21	56	22	11	
82	8	4	22	65	16	14	
115	17	4	23				
57	11	4	24				
79	5	4	25				
103	16	5	26				
74	2	6	27				
84	12	7	28				

SUMMARY:

SUMMARY.								
CLASS A					CLASS B			
The several numbers of diff. errors.	No. of pupils missing this No.	TOTAL MISSPELLINGS.			No. of pupils missing this No.	TOTAL MISSPELLINGS.		
		Final Test.				Final Test.		
		Prelim. Test.	Same words.	Different words.		Prel. Test.	Same words.	Different words.
0	7	404	13	0	3	97	6	0
1	10	514	12	10	4	162	13	4
2	3	256	9	6	4	208	24	8
3	1	44	2	3	2	136	12	6
4	4	333	41	16	1	54	10	4
5	1	103	16	5	1	57	4	5
6	1	74	2	6	1	35	4	6
7	1	84	12	7	1	90	23	7
8	0				2	150	45	16
9	0				1	65	13	9
11	0				1	56	22	11
14	0				1	65	16	14

AVERAGES FOR EACH GROUP OF "NUMBERS OF DIFFERENT WORDS MISSED IN FINAL":

0	7	57.7	1.9	0	3	32.3	2.0	0
1	10	51.4	1.2	1	4	40.5	3.3	1
2	3	85.3	3.0	2	4	52.0	6.0	2
3	1	44.0	2.0	3	2	68.0	6.0	3
4	4	83.3	10.3	4	1	54.0	10.0	4
5	1	103.0	16.0	5	1	57.0	4.0	5
6	1	74.0	2.0	6	1	35.0	4.0	6
7	1	84.0	12.0	7	1	90.0	23.0	7
8	0	0	0	0	2	75.0	22.5	8

FURTHER CONSIDERATION OF THE VARIATION.

There seems no discoverable relation between initial correct spelling and the likelihood of misspelling words in the final test that were not misspelled in the preliminary test, which shows the

presence of the factor of guessing. It might be supposed that the poorer spellers do most guessing, but the records hardly bear out this supposition. Thus, pupils No. 2 and No. 27 in class A both misspelled 74 words in the preliminary test. Pupil No. 2 missed none in the final, but pupil No. 27 missed 8 in the final, 6 of which he had not missed in the preliminary test. Pupil No. 2 certainly did less, or perhaps better, guessing than pupil 27. Again, the group missing 6 different words in Class B had an average misspelling of but 35 words in the preliminary test, which was the next to the lowest average of any group in either class, and very much lower than the 0 group in Class A, which had an average of 57.7 in the preliminary test.

The chances of correct guessing and of incorrect guessing in such work as this can be worked out actually for these two groups of children. In Class A, 7 pupils missed only words in the final which had also been missed in the preliminary, and 21 missed different words in the final. Correct guessing, if present, seems to have hit it in proportion of 1 to 3. The 21 pupils missed 53 such words, or an average of 2.52 errors per pupil. If among the pupils the proportion was 1 to 3, and each pupil making an error made 2.52 errors, the chances of correct to incorrect guessing that actually materialized here were 3 times 2.56 or 7.68 to every correct guess. In Class B, the chances among the pupils are 3 correct to 19 incorrect, or 6.33; now the 19 pupils missed 90 words, an average of 4.74 words each. Since 6.33 times 4.74 equals just about 30, we have here 30 chances of error to 1 of correctness that is actually realized. Thus the assumption of correct and incorrect guessing on the part of contrasted groups of children, or between contrasted methods, is shown to be entirely untrustworthy and unscientific. The incorrect guesses of the one group certainly did not offset those of the other. The Class B, which were the better spellers at the start, make almost twice as many such errors as Class A. Incidentally, this constancy, whether positive knowledge or merely a keener guessing power, seems to further show the advantage of the grouping method of study, since Class A had much the smaller percentage of such errors.

XII. VALIDITY OF PRELIMINARY TEST.

This variation very certainly casts doubt on the absolute dependence upon the results of the preliminary test as measuring the point from which advance is made. If the preliminary tests were corrected for each of the two classes, Class A would lose 1% of its preliminary standing, and Class B about 3%. No correction of the results has been made to incorporate these variations. The final test would certainly show some variations,

therefore the results are presented with this mere statement of the fact that a trifling variation is present. This is probably the astronomer's "personal equation." It may be of value, however, to suggest that some future investigation should be made to ascertain, if possible, what is the percentage of variation that must be allowed in preliminary tests. It is of course greater than in final tests after teaching and drill on a subject. Its approximate value can be determined by several trials of a test with the same groups of children, and will be a valuable factor to know in all experimental pedagogical work.

XIII. THE EFFICACY OF THE RESPECTIVE GROUPS OF WORDS.

Besides the value which this investigation may have in the light it throws upon "grouping vs. non-grouping" as a method of study, an analysis of the effectiveness of the several kinds of grouping here resorted to may be of value in suggesting the kinds of grouping to use in the method, since not all the groups appear to have been equally effective. Therefore, the following table of results in Class A, the children who studied by the grouping method, will indicate whatever efficacy any group had.

THE COEFFICIENT OF EFFICIENCY OF GROUPING.

It seemed desirable to compare the respective groups with each other as to efficiency; to do so, a standard must be fixed, and a method of comparison worked out which should resolve itself into a single amount or number, indicating efficiency as compared with the standard group. Since original and final status should appear in the computation, the following method of computing the coefficient was decided upon.

An inspection of the entire 30 groups showed two very desirable qualities inherent in the results for group 17. First, it is almost the mathematical median of the entire 30, and second, in the final test all its words were spelled correctly, so that its efficiency is 100%, which means that all was learned that could be learned in that group. This group having been fixed upon for the standard, the average number of misspellings of the words in the group in the preliminary test was found, and it was 8.33: this then was treated as the standard of difficulty of the words, and the comparative difficulty of the words in any other group, for these 28 children, of course (and not for the world in general) was found by dividing the average misspellings in any other group by this 8.33. Thus, group 2 it will be seen has an average of 16.5 misspellings, which means, according to the comparison here proposed, that the words of group 2 were twice as difficult at the start as those of the standard group—group 17: this becomes one factor of the coefficient of efficiency.

Next, the percentage of improvement in each group must be compared with the percentage of improvement in the standard group: out of these comparisons, a compound proportion grows which is easily resolvable, and workable by a simple rule. Group 2 showed an improvement of 90%, and if we compare groups 17 and 2 we get this proportion:

		Av. Misspell.	Improvement.
Group	2.....	16.5	.90%
"	17.....	8.33	100%

If group 17 be now called an efficiency of 1, what efficiency has group 2 shown? • Here is the answer:

$$x : 1 :: 16.5 : 8.33$$

90. : 100, which may be simplified into this—

$$x : 1 :: 2 : 1$$

.9 : 1, which yields us the result—

$x = 1.8$, as the efficiency of group 2, and also the simple

rule that degree of difficulty multiplied by the decimal ratio of their percentages of improvement will yield the coefficient of efficiency. It is by this method and by this rule that the coefficients of the following table were computed:

Group.	AVERAGE MISPELLING.		Gain. %	Coefficient of efficiency.
	Preliminary.	Final.		
1	19.5	1.00	94.84	2.22
2	16.5	1.80	90.	1.79
3	16.	1.75	78.	1.5
4	16.	1.98	88.2	1.7
5	15.5	1.75	80.	1.66
6	14.6	1.8	87.6	1.53
7	14.	2.	83.	1.42
8	12.5	.5	96.	1.44
9	12.14	1.4	93.	1.36
10	11.85	1.2	93.	1.32
11	10.38	1.25	87.95	1.09
12	10.2	.8	92.15	1.13
13	9.7	.75	86.2	1.01
14	8.87	1.33	91.7	1.56
15	8.8	.4	95.5	1.53
16	8.8	.00	100.	1.06
17	8.33	.00	100.	1.
18	8.11	1.00	87.52	.85
19	7.7	1.	78.	.72
20	6.5	.5	92.3	.72
21	6.45	1.11	86.1	.66
22	6.	.00	100.	.72
23	5.6	.5	78.1	.52
24	5.11	.22	96.	.58
25	4.8	1.2	75.	.43
26	4.63	.7	98.65	.55
27	4.14	.43	89.9	.45
28	1.75	.25	87.	.18
29	1.4	.2	86.	.13
30	1.33	.33	75.	.12

It may be of interest, and even of added value, that the group chosen as standard has an average of misspellings almost equal

to that of the average of misspellings of the entire list, which is 8.86, or just about the same as group 14.

It appears that both the most and the least effective group is etymological, that is group 1, with a coefficient of 2.22, and group 30 with a coefficient of .12. Groups 18 and 21 offer a striking contrast: Group 18, the nouns ending in "y," singular, preceded by a consonant, for whose spelling there is an easy rule, is .85, and for group 21, the singulars of the same nouns, for whose spelling there is no rule, the coefficient is but .66. Seemingly, here is another corroboration in favor of the study by grouping according to spelling difficulty.

The size of the groups seems to have had little or nothing to do with the efficiency; group 4, with 11 words, is more efficient than group 5, with 4 words. The etymological groups clearly do not show a marked higher efficiency, for they are found scattered quite evenly throughout the table, in places 1, 3, 10, 12, 17, 20, 28, 30. Since most of the other groups were phonetic or the equivalent of phonetic, the same conclusion must be drawn for that kind of grouping. It seems probable, however, that with older pupils there might have been evidence of higher efficiency of the etymological grouping, since that appeals to reasoning as well as to analogy of literal form. In sixth grade children this form of comparison and association is just beginning to show itself. The earlier habits of the children were at least as strong as the factor which the investigation was bringing consciously into operation in their study. Group 26, the largest group in the lot, containing 16 words, is near the end of the list, with an efficiency of .55. Group 23, with 12 words, shows an efficiency of but .52. In both cases, however, it is not the size of the group, but the ineffective grouping that is the cause. In both groups, the grouping errors are but a small part of the actual errors, which once again emphasizes the necessity of including the same word in different groups according to the number of difficulties of actual spelling which it contains.

XIV. SUMMARY.

1. Preliminary Tests are not absolutely but only approximately correct as a point from which to measure improvement due to a method of instruction.

2. Grouping words into lessons according to spelling difficulty is better than the ordinary plan of spelling lessons. It secures better daily lessons, better final results, and greater steadiness or constancy of correct spelling.

3. Computation of gain or improvement should be upon the basis of the "unknown" in the preliminary test, so as to secure comparable results from all experimental investigations.

4. A word should be grouped with as many separate groups as it contains real spelling difficulties. In any one group this focuses the attention upon but one difficulty, making mastery of that more probable, and in the end all its difficulties will be mastered.

5. It is not safe to assume that variations to right and wrong "offset" each other in large numbers of children, unless the chances of error and of correctness are exactly equal. Where the chances of error outnumber the chances of correctness, even if the average number of guesses on the two sides be equal, the errors will outnumber the correct variations.

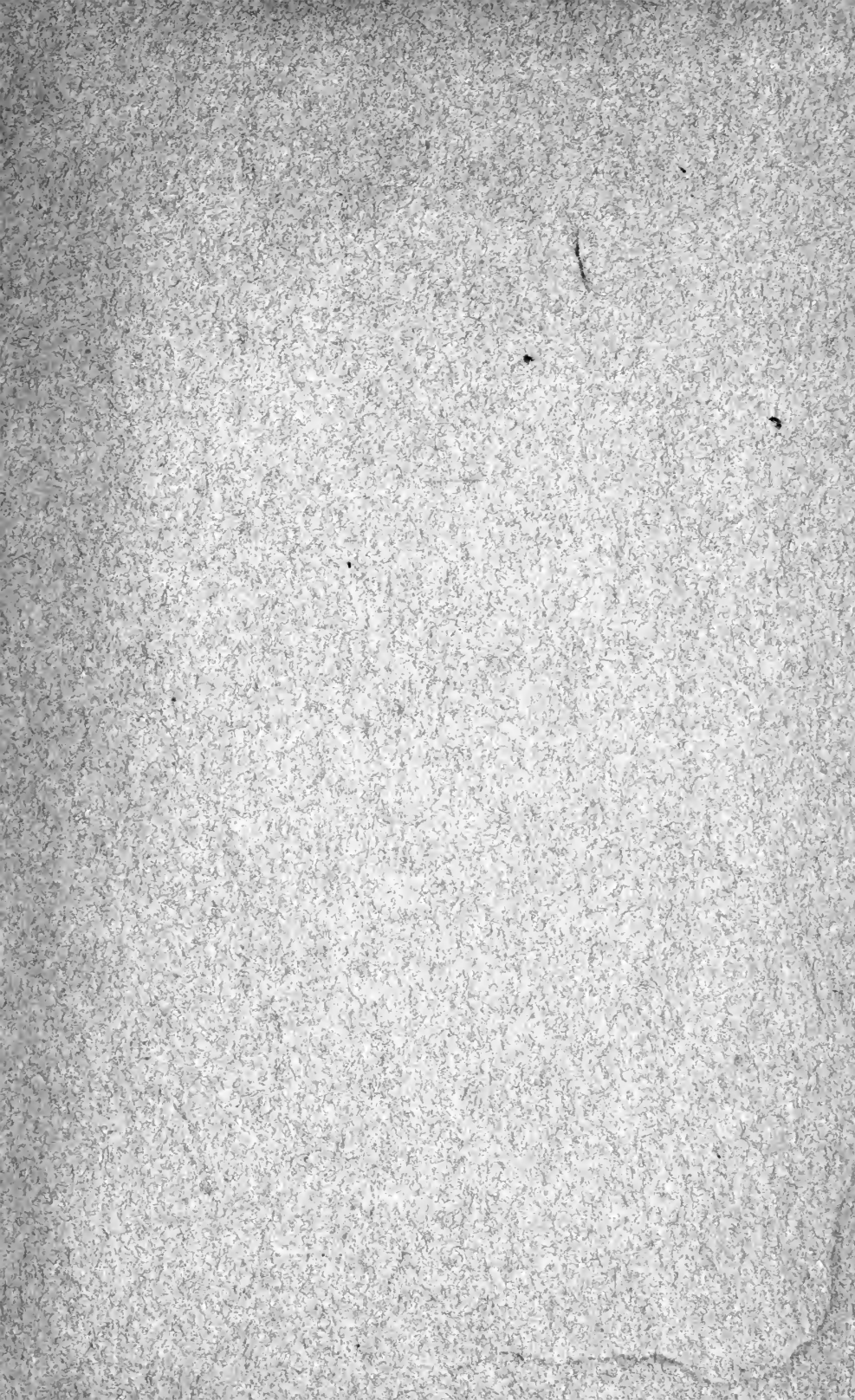
6. Grouping shows its effectiveness by every test to which we submit the figures, even among the groups themselves.

7. A coefficient of efficiency for the matter of instruction can be found by adopting a standard mass or unit, and then, through the results of a preliminary test, ascertain the relative difficulty of other units or masses, and multiply this ratio of difficulty by the ratio of improvement between the standard mass or unit and any other unit, as shown by the final test.

8. Is our present plan of counting each misspelled word as but one wrong, regardless of the number of errors it may contain, conducive to the highest efficiency of method in spelling? Would not the counting of the actual errors, by calling attention to each error specifically, result in having most effort applied at the point of greatest resistance?

9. A method is proposed to equate original difference of groups of children, so as to secure a basis for comparison of contrasted methods. The rates of gain should be to teach each other as the percentages of standing in the preliminary test, and also as the percentages of "unknown" in the preliminary test. Equating the percentages of the preliminary test equalizes acquiring power, and equating the unknown of the preliminary test equalizes the chances of learning. This applies only to tests where the entire field or body of matter comprehended in the preliminary test is also covered in the teaching or learning of the two contrasted groups. This method of computing enables us to show what one class should do in terms of the other, thus giving us a *ratio* of comparison before final results are known. Prediction of the result thus becomes possible with a high degree of probability of its approximate tendency in the right direction.

10. THE STUDY OF WORDS ARRANGED INTO GROUPS ACCORDING TO SIMILARITY IN SPELLING DIFFICULTY IS 20 PER CENT. BETTER THAN THE USUAL NON-GROUPING METHOD OF ARRANGEMENT AND STUDY.



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